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PIT-TIMBER AND ITS PRESERVATION.

A PAPER READ BEFORE

THE MIDLAND INSTITUTE OF MINING, CIVIL, AND MECHANICAL ENGINEERS

BY

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GENERAL MEETING AT LEEDS,
March 21st, 1916.

Excerpt from the Transactions of The Institution of Mining Engineers,
Vol. LI., Part 2, pages 190-203.

LONDON: PUBLISHED AT THE OFFICES OF THE INSTITUTION,
Albany Buildings, 39, Victoria Street, Westminster, S.W.
[Telegrams: "Instimini, London." Telephone: P.O. Victoria 2149.]
Printed by Andrew Reid & Company, Limited, London and Newcastle-upon-Tyne.

1916.

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The wastage of timber in coal-mines that is caused by decay is very great; in fact, far greater in this country than is generally realized. Mr. E. W. Peters* estimates that of the whole wastage of timber in mines in the United States of America, 50 per cent. is due to decay and insects; of this 50 per cent., an overwhelming part is due to decay. The most efficient methods of decreasing this grave loss can be devised only by co-operation of the mining engineer and the scientific expert, and it is partly in the hope of procuring such collaboration that this paper is written. It contains, therefore, a *résumé* of our present knowledge of the decay of wood, and of the economic methods of checking this in mines; but, with a view to improving those methods, it also directs attention to the gaps in our knowledge, and the means by which these can be filled by future investigation.

The decay of wood in the overwhelming majority of cases is caused by wood-destroying fungi. The first step towards such decay is the infection of the wood, either by means of microscopic spores wafted through the air, or by the body (*mycelium*) of the fungus advancing from already infected material. In either case, fungal threads entering from the outside penetrate, grow within, and gradually permeate and destroy the wood.

Spores are produced in myriads by easily visible fructifications, which assume the forms of mushrooms, brackets, or sheets. Consequently one method of decreasing infection is to destroy these fructifications before they have produced or shed their spores. Such a collection and destruction of fructifications in coal-pits may sometimes be impracticable. On the other

* "The Preservation of Mine Timbers," by E. W. Peters, 1912, U.S.A. Forest Service, Bulletin No. 107.

hand, its efficiency may be underestimated; but the writer may point out that largely by this means the tinder fungus was practically exterminated in a large forest in Germany. Before this method is attempted, it is essential to know which fungi are doing serious damage in coal-pits; for this and other reasons it is necessary to identify critically the various fungi present.

Unfortunately, many kinds of fungi readily produce spores quite apart from such fructifications, the destruction of which might therefore be relatively futile. For this and other reasons, it is necessary to work out the life-histories of the fungi present in coal-pits; and we may then also learn how to prevent or decrease the production of spores.

Infection may take place by threads of the fungus advancing from an infected to a sound piece of wood. According to their mode of growth, wood-destroying fungi may be ranged in two groups. In one group the fungus, having established itself at a point in the wood, not only gradually grows within the wood, but also emits threads that emerge from the wood, grow rapidly over the surface, clothing this with growths, often white, and shaped like strings, sheets, or cushions.* These superficial growths in turn send threads into the wood, and thus feed upon it. Especially by means of these exposed string-like growths the fungus can pass from one piece of wood, through dirt or even brick walls, over stones, coal, or iron, and can infect a sound piece of wood several yards away. Fungi of this kind are very familiar in certain coal-mines, and are locally known as "cotton mould fungus." Mining engineers will at once call to mind a number of the ordinary operations in coal-mines that serve incidentally to transmit infection to sound wood from timber already attacked by fungi of this group.

In the other type of attack the fungus advances more slowly; for, having entered the wood, it eats its way steadily into the interior, and keeps at a certain distance from the outside. Wood infected by such fungi, especially when it is discoloured by various agencies in coal-mines, may show no appreciable external sign of its rotting condition, even when a shallow incision is made with a knife. This type of attack is certainly

* These must not be mistaken for fructifications, which often differ from them in colour, and usually display radiating gills (cp. mushroom) or crowded little pores, teeth, or pimples.

abundant in coal-mines (the writer has himself seen cases), and where it alone occurs the miner may readily, but wrongly, assume that his mine is free from decay. Here and there the fructifications of such fungi will betray the secret.

These considerations suggest that in a coal-pit where the swift-growing fungi of the first group are especially present, the durability of the timber may be considerably increased by rendering the surface of the wood resistant to infection; but where decay is largely due to the stealthy, slow-growing, internal fungi, decreased loss may often be more easily secured by destruction of the fructifications. The facts emphasize the necessity for enquiry into the life-histories of fungi in coal-mines.

The statement is frequently made with reference to certain coal-mines that there is little or no loss due to decay of wood. Facts just mentioned suffice to prove that such statements cannot be accepted without fuller investigation, even when pit-props break though apparently perfectly sound.

It may at once be admitted that in dry pits, or where the mine water is very rich in salts, there may be little or no decay; and it may also be admitted that props exposed to great pressures break while in a sound condition. Decay may thus play little or no economic part in certain deep coal-mines. Yet, if it be found that there are coal-mines free from decay, but showing conditions essentially similar to other pits in which decay is rife, then we arrive at the fundamentally important conclusion that the decay of wood in mines may be checked by the cheapest of all means, namely, sanitation of the simplest kind. It therefore becomes evident that we must acquire by investigation a thorough knowledge of the conditions prevailing in coal-mines, and this becomes doubly clear by a consideration of the effects of external conditions on the growth of wood-destroying fungi.

For the purpose of respiration, such fungi require a free supply of air, and particularly of oxygen, but they also demand an adequate supply of water. It is, therefore, clear that wood, either very dry or very wet, is generally safe from decay. When very dry, it has the air but not the moisture required; when water-logged, it lacks the requisite amount of air.* These

* Some woods decay relatively rapidly under water: the extent to which very wet wood in mines is destroyed by bacteria and the extent to which the latter are responsible for the production of marsh-gas ("firedamp") are unknown, and call for investigation.

facts, partly at least, account for the practice adopted in some countries of regularly drenching the wood with water, and for the circumstance that wood under an unceasing flow of water in coal-mines is generally durable.

As fungi will attack wood only when it contains more than a certain minimum and less than a certain maximum of water, we can understand why decay is often more pronounced along the return roads than along the intake, and why, in relatively dry mines, decay is worst in the wettest places, whereas in moist pits the reverse is the case.

Different kinds of fungi differ as regards the degree of dryness or wetness of the wood under which they can successfully thrive. One species, *Merulius lacrymans* (causing the worst form of dry-rot in buildings, and probably active in many coal-mines), when once established, can attack the driest wood. In respiration this fungus produces water in sufficient quantity to render the infected wood moist, wet, or sodden. It thus renders the wood liable to attack by other fungi that demand more water; indeed, in a relatively dry mine the extermination of *Merulius* alone might indirectly thus lead to the extirpation of some or all the other kinds of wood-destroying fungi present. This case again emphasizes the necessity for investigation into the conditions of existence of fungi living in coal-mines.

In order to protect wood against decay, it is sufficient to keep it absolutely dry or soaking wet.

Apart from the practical difficulty of keeping wood in pits wet, it must not be forgotten that wet wood is much weaker than dry wood (sometimes having only one-third the strength).

On the other hand, at present it is not economically practicable to prevent the ingress of air or moisture into pit-timber, for continuous impervious coatings are difficult to secure and maintain. Consequently, the protective effect of seasoning wood before use in coal-pits is determined by the dryness or wetness of the mine. If, for instance, pit-props be barked and then seasoned, their superficial dryness tends to protect them from decay so long as they remain dry; but wood is hygroscopic, so that in wet mines such props soon relapse into their former moist and vulnerable condition. On the other hand, if unseasoned props with intact bark be utilized in relatively dry mines, the intact bark acts as a shield against infection; but, as the

wood slowly and gradually dries, it shrinks, and in the bark there arise cracks, through which infectious spores gain entrance to the relatively moist wood within. These considerations supply an explanation of the contradictory results obtained by Mr. Peters in the United States of America, where barking the props was found to increase their durability in dry mines, but not in wet mines. In our own country the collection of statistics as to the relative humidity of the air in various coal-mines would give valuable indication as to the extent to which seasoning and barking, or the latter alone, would serve to preserve pit-props. The seasoning and barking would not only directly increase but also prolong the strength of props, and the significance of these facts may be especially great in the case of deep pits.

Yet dryness to some extent favours the production of fructifications, and consequently of their spores. Consequently such fructifications are, often at least, more developed along the intake roads than along the return; moreover, repeated drenching of wood tends to check the production of such fructifications.

The relatively high temperatures prevailing in coal-pits accelerate decay, since, so long as sufficient moisture is present, the activity and growth of the fungus are (within limits) proportional to the temperature. But each species of wood-destroying fungi grows only within certain ranges of temperature; for instance, *Merulius lacrymans* may be found growing in mines the temperatures of which lie below 80° Fahr., but not possib in deep coal-pits where the temperatures rise above this point. Of greater practical importance is the fact that exposure to high temperatures, especially associated with moisture, serves to kill fungi and their spores. Thus it is easy to sterilize pit-timber, and such sterilization often takes place during the process of injecting preservative liquids into wood. It must be remembered, however, that prolonged exposure of wood to temperatures above the boiling-point of water materially weakens the timber.

To digress for a moment from the question of decay induced by fungi, attention may be directed to the fact that the relatively high temperatures prevailing in coal-mines tend to promote the disintegration of wood by chemical agents. For instance, zinc chloride, a very efficient and economical wood-

preservative, can gravely attack timber when used in sufficient concentration at only moderately high temperatures. Iron sulphate, either applied as an antiseptic or casually occurring in mine water, undergoes decomposition, yielding sulphurous and sulphuric acids, the destructive action of which on wood is intensified by rise in temperature.

Wood-destroying fungi require appropriate raw food-material. Some of them can feed upon the sap-wood or heart-wood of many different kinds of timber; others can attack only hard-woods or only soft-woods, and sometimes only the sap-wood of these; still others may be greater specialists, and capable of attacking only one group (genus) of timbers, say, pine-woods. These facts provide a possible means of decreasing decay by selection of an appropriate immune kind of wood to replace decayed timber that has been removed; for instance, if the fungus occurring locally or generally in a pit exclusively attacks soft-woods, these (pine, spruce, larch) can be replaced by a hard-wood. Or again, if a pine pit-prop be rendered rotten by a fungus that cannot attack larch, it may be replaced by a larch prop; this will then not be infected from the pine coupling, which is also probably decaying from the same cause. But, before this economical method of sanitation can be applied, it is necessary to have full information as to the habits of the fungi concerned, and for this research is necessary.

The facts already stated serve to explain why it is that the durability of one and the same wood varies in different pits, and why the relative durability of different woods in different mines is not always the same. At Commentry, in France, the following were the estimates as to durability of pit-wood :—

Pit-wood.	Months.
Oak	50
Beech	24
Pine, cherry, rowan, birch, and poplar	18
"False acacia" (*Robinia*)	9
Hornbeam and sycamore	6

At the same pits the following was the order of durability noted in certain observations—the list beginning with the most and concluding with the least durable :—Oak, Scots (Baltic) pine, alder, ash, cluster pine, "false acacia," willow, sycamore, elm, aspen, cherry, birch, hornbeam, beech, and poplar (other than aspen). The different position of beech in the two

lists is noticeable. In this country Scots (Baltic) pine, cluster pine (from France), larch, oak, with some small quantity of ash and birch, appear to be the woods chiefly used: it is also stated that in some pits Norway spruce is employed. Of these timbers, larch and oak are the most durable at ordinary levels. As to the comparative durability of these woods in pits in this country, the writer has no statistics available.

It is assumed that the different kinds of wood vary in durability in accordance with the amount of fungus-repelling or antiseptic material that they contain or produce when attacked. And this leads to the fact that artificial durability may be given to timbers by the application of antiseptics or fungicides. All solutions may act antiseptically if sufficiently concentrated: for instance, sugar, though a food admirably suited to promote the growth of fungi, when concentrated arrests the growth of these.

Common salt (sodium chloride) in concentrated solution is an antiseptic, and when naturally abundant in coal-mines undoubtedly protects the wood. But its hygroscopic qualities and relative weakness of action seriously detract from the value of common salt as an artificial antiseptic.

Ferrous sulphate is very uneven in its effects, sometimes considerably prolonging the life of timber, at other times being associated with rapid decay. Undergoing oxidation, it deposits oxide of iron on and in the wood, and thus tends to check the ingress of water; but it produces sulphurous and sulphuric acids, which may on the one hand attack the wood directly, and, on the other hand, successively act as an antiseptic and a food-material in relation to fungi. These facts suggest as worthy of trial the whitewashing of bare wood in pits where ferrous sulphate is abundant in mine water. The lime present will neutralize the acids, and tend to form an impervious sheet outside the wood.

Corrosive sublimate is not to be recommended, as being extremely poisonous. It is dangerous to handle; moreover, it is easily washed out, and is volatile.

Copper sulphate as a fungicide in wood gives remarkably variable results. Sometimes it is very efficient, but in other cases it causes very rapid disintegration of the wood (possibly because of free acid). In the presence of ferrous sulphate its destructive action is especially marked. Hence, copper sul-

phate cannot be recommended for use, and must be especially avoided when mine water contains ferrous sulphate.

If initial cheapness and prolonged efficiency be taken into consideration, *zinc chloride* is the best inorganic fungicide for use in connexion with the preservation of wood. As a superficial wash, its value is diminished greatly where the wood is exposed to rain. In efficiency it is surpassed by several other costly salts, such as magnesium fluosilicate.

Creosote and its derivatives constitute the most satisfactory preservatives of wood, for creosote is a more powerful fungicide than zinc chloride, and is not washed out. Moreover, if the wood be seasoned, creosote retards the absorption of water, and thus indirectly contributes to the strength of timber in moist places. Among the cheaper derivatives of creosote may be mentioned cresol calcium, which is being tested on railway sleepers. The most efficient derivatives, however, are the dinitro-phenates and cresates of sodium and potassium, and one or more of these, with admixtures of other substances, may become of commercial importance in this connexion.

But, as is shown by the succeeding table summarizing Fayol's observations, prolonged investigations and trials are required to show the relative efficiency of various treatments in different coal-mines, as in some cases simple measures, or cheaper or more dilute antiseptics, are as efficient as more costly antiseptic treatment.

Moreover, the measures to be adopted vary with the length of service required of the timber: for instance, it is superfluous to protect against decay a piece of wood which is required to serve only for a very short time (say, two months), or which breaks under pressure long before it could be mechanically weakened by decay.

The series of treatments considered in the succeeding numbered paragraphs represent for the most part a progressive rise in cost of treatment and in enhanced durability.

(1) Seasoning and barking of wood have effects the limited efficiency of which has already been discussed. It may here be added that Peters found that in dry, well-ventilated mines seasoning sometimes increased the durability of the wood by 25 per cent.

(2) Carbonizing or braizing the outside of timber serves to

provide an aseptic or antiseptic and at least temporarily dry surface, which, however, is liable to be subsequently broken. Fayol's table dealing with the Commentry mines shows that this treatment is often ineffective, though sometimes efficacious.

(3) Painting the surface of the wood with various antiseptic liquids yields limited and uncertain results, as it is difficult to secure and maintain an absolutely continuous antiseptic coating. Nevertheless, where the antiseptic could not be washed off, and the substance used was creosote, Peters showed that seasoned loblolly pine had an increased durability of from 50 to 100 per cent. Hence this treatment is of value where the amount of wood requiring preservative is small, and where the period of required service is moderately short (say, 2 to 4 years).

COMPARATIVE DURABILITY OF PIT-PROPS IN COAL-MINES AT COMMENTRY (COMPARED WITH UNTREATED WOOD, WHICH IS RECKONED AS 1).

Nature of the wood.	Immersed in, or treatment.						
	Mine water.	Superficially braized.	Tar.	Creosote.	Sulphate of copper.	Sulphate of iron.	Chloride of zinc.
Oak, common ..	10·4	1	14·4	3·6	38·4	28·8	14·4
Cluster pine ..	1	1	{50, 2·33}	40	5·33	2·66	8
Alder	1	1	2·11	40	4	10	40
Beech	1	1·37	6	1·75	50	7·5	50
False acacia (*Robinia*) ..	1·2	7·22	5·33	2·2	8	26·6	40
Hornbeam ..	3	2·5	7	15	—	12	50
Sycamore ..	2·5	3	6	12	7·5	—	—
Cherry	1·66	—	3·16	—	2·5	1·83	—
Aspen	1	—	2·5	—	2·5	8	—
Birch	1	—	—	—	2·66	13·33	50
Poplar (not aspen) ..	1	—	2·2	—	11·33	2·61	—
Sorbus (rowan, etc.	—	—	1	—	—	50	28
Range ..	10·4–1	7·22–1	(50) 14·4–1	40–1·75	50–2·5	50–1·83	50–8
Average ..	2·25	2·44	(9·06) 4·73	16·36	13·22	14·85	35·05

Duration of immersion —12 hours in the case of the salts of iron, copper, and zinc ; 30 minutes in the case of tar and creosote.

The strengths of the solutions were respectively : iron sulphate, 5 per cent ; copper sulphate, 10 per cent ; zinc chloride, 10 per cent ; the creosote and tar were heated to 140° Cent.

(4) Immersion of the wood in a warm or hot tank of antiseptic is more efficient than the mere painting of the surface with the same preservative, for a more continuous antiseptic coating and deeper penetration are obtained. The accompany-

ing table giving Fayol's results at Commentry demonstrate the efficiency of the method in the cases of various timbers and antiseptics. The table must not, however, be taken as an accurate indication of the comparative efficiency of the various antiseptics. Some of Peters's observations in America seem to illustrate the superiority of tank treatment over mere brush work on the surface; for Peters noted that tank treatment with the relatively weak antiseptic solution, common salt and magnesium chloride (15 per cent.), gave greater durability than brush treatment with the potent fungicide creosote. Where the amounts of timber to be preserved are not great, tank-treatment is the simplest and most economical method that can be applied, if the period of service required of the wood is considerable.

It must be noted, however, that too prolonged treatment in a bath at a temperature exceeding the boiling-point of water weakens timber, so that pit-props are then apt to fail by rupture.

(5) Thorough impregnation of the wood by means of pressures exceeding one atmosphere constitutes the method of applying antiseptics that is most efficient, and, where large quantities of timber are concerned, most economical. This method is well illustrated by the familiar process of creosoting by pneumatic pressure in closed chambers. Of this normal process there are various modifications, some being designed to ensure thorough penetration of the wood, succeeded by an expulsion of the excess of creosote. Possibly one of these modifications will be found the most suitable in connexion with coal-mines. So far as decay is concerned, such thorough creosoting involves an increase in durability from perhaps a month or two to an indefinite number of years (creosoted wooden fences still perfectly sound after forty years of use, and railway sleepers free from decay after more than twenty years of use in one form or another, are known).

The main conclusions in this paper may be summarized as follows:—

By means of research into the identities, life-histories, and conditions of growth of fungi causing the destruction of wood in coal-mines, we may hope to initiate a new policy, that of *militant sanitation*, involving the suppression of decay by the most economical of all methods.

In less favourable cases, by an analysis of the conditions prevailing in coal-mines and by a consideration of the required durability of the wood in various cases, we can improve upon the current methods of mere *defence* by selecting the cheapest and most suitable method known or discovered by future research.

The efficiency of the methods and the resultant economic profit will depend upon the amount of research and the extent of the co-operation between scientific and mining experts.

Such increased preservation of timber involves a saving not merely from the point of view of the colliery proprietor, but also in the amount of timber imported into this country; for most of our pit-props come from the Baltic region and some from France. With the continual rise in the price of soft-wood timber, this saving will increase with years. W. F. Sherfesee,* assuming that in the United States of America the average life of an untreated pit-prop is three years, and of an antiseptically treated pit-prop thirteen years, and that 40 per cent. of mine timber could be profitably treated antiseptically, concludes that the annual saving to the United States of America involved by such treatment would be 51,700,000 cubic feet of timber. Without relying too greatly on Sherfesee's estimates, and still less without applying them to this country, we may hold that they sufficiently indicate the immensity of the saving that may be possible in this country by improved sanitation and appropriate treatment of wood in mines.

The Chairman (Mr. Thomas Beach) said that doubtless a great deal might be done to preserve timber used underground, but in the majority of the pits in their district the timber was broken before it had a chance to decay. In some of the shallower mines, however, where timber might stand for years, very great economies could be brought about by some method of dealing with the fungi in the manner indicated in the paper.

Prof. W. G. Fearnsides (Sheffield University) said that in a number of the shallower mines between Leeds and Sheffield,

* "Wood Preservation in the United States," by W. F. Sherfesee, 1912, U.S.A. Forest Service, Bulletin No. 78.

especially in those where gannister and refractory fireclay was being won along with the coal, one could not help noticing the luxuriance of the fungoid growths. The speaker, when he visited pits, went as a geologist, but having once had to learn something about the parasitic habits of the mushroom class, he had felt bound to tell the colliery officials that their timber could not continue to nourish such growths without a corresponding loss of strength. He believed it was because an infected prop had been brought to daylight for his inspection, and was afterwards sent on to Prof. Groom, that the latter was now at Leeds discussing with them the general question of pit-timber preservation.

From what he had himself seen underground, he quite agreed that probably the most hopeful way of dealing with the fungi was to clear away their fructifications before the spores ripened. Infection by spores was certainly important underground, and with new timber in a new place one could generally notice that the onset of fungi was from the windward side. Once started, the growths spread vegetatively to the lee, and usually the large "cushions" and filmy festoons which are the outward manifestations of the fungi at the phase of their maximum destructiveness are always most abundant in those damp dank places where the ventilation of the mine is "slack." As to the amount of the damage done by fungi in the coalfield, the speaker could not do more than guess. It seemed to him that, since the total weights borne by the timber in shallow mines are so much less than the weights carried in deep mines, mechanical breakages ought, therefore, to be less in shallow than in deep mines. He had always heard that timber charges per ton of material wrought in the gannister mines were higher than those in any other class of mine in the coalfield, and were considerably higher than the average of timber charges over the coalfield generally. He felt sure that in gannister mines a great deal of timber destruction was accomplished by fungi, and he thought that anything which would prevent the onset of fungi in these mines would save a very considerable quantity of timber and would be well worth while.

The whole question was certainly not an easy one, and there were many conditions beyond those which met the eye. He would like to suggest that acidity of pit-water was a condition

which favoured the rapid spread of fungi, and he thought that the composition of the water, as well as the temperature, humidity, and composition of the air, should be subjects for enquiries collateral with the investigation of pit fungi from the botanical point of view.

Mr. W. D. Lloyd (Altofts) said that (so far as the deeper pits were concerned) he thought that the paper conveyed rather an erroneous idea of the amount of saving that was likely to be obtained in the timber bill. In a great many mines in the district, fully 75, and in some cases at least 90 per cent. of the timber was used on the coal-face, and was set at most only three or four times before it was broken up, so that as its life was but a few weeks or months, there was no chance of decay setting in before the timber was rendered useless. He had had experience in the Midlands, in Lancashire, and in Yorkshire, and he could only recall one case in which timbers had to be renewed owing to decay was there, but, at the same time, the proof as to harm caused by the decay depended on whether the timber had to be renewed or not. The case that he had mentioned was rather curious in some ways: a large number of unpeeled larch bars were set in a return airway in a saturated atmosphere of about 58 degrees, and after being in for two years they all started to fail from decay; but the remarkable point was that the Norway pine props, on which the bars were supported, were not attacked in any way.

From the figures given by Prof. Groom with respect to American mines, and from what had been stated concerning shallow mines, it would appear that a saving might really be effected in those pits, but not in the deeper mines. He imagined that there could not be a better condition for the preservation of timber than in the return airways of some of the Yorkshire mines, at a depth of 500 to 800 yards, where the temperature was from 70 to 80° Fahr., with a difference of 4 or 5 degrees between the dry and wet bulbs. Under such conditions there was, so far as one knew, no tendency whatever for decay to set in. He had seen within the last year or two oak pit-props that had been underground for over 50 years, and, when these were cut into sections, there appeared to be no decay in them. The props were at a depth of about 230 yards, and had been shut up in a more or

less stagnant atmosphere for the greater part of that time in a place that was fairly moist.

Mr John Gill (Normanton) said that the colliery with which he was connected, working a seam at a depth of about 300 yards, was occasionally wet and occasionally dry. The timber was affected by fungi both in the returns and in the intakes, but in quite a different manner. The fungi attacked the bars in the returns, and the foot of the props in the intakes, and he would like to know the reason for this difference. The mine was wet and fairly warm, and a great number of shots were fired in it. The timber had to be changed frequently; in fact, at the present time iron was being substituted for wood in the intake on account of the props being attacked from the bottom.

Mr. R. Nadin (Brierley) said that at a shallow pit 218 yards deep with which he was connected they were troubled with fungi, particularly where the ventilation was slack. In some districts, even the props in the bords were attacked. The seam was worked on the bord-and-pillar system, the bords being driven up a distance of 100 yards, and by the time the pillars were worked back the timber supporting the bords was in some cases attacked by the fungi. Prof. Fearnsides had visited the colliery recently, and had remarked on the condition of this timber. Since then he (Mr. Nadin) had had the large timber painted with a mixture. He could not yet judge whether this treatment was beneficial, but he hoped that it would save money.

The Chairman said that when timber decayed it generally did so between wind and water. If they burned the foot of a stake, or coated it with tar or creosote, it would last much longer. He had one case in mind where the whole place was covered with cushions of fungi, but there was very little weight on the timber. It would be interesting to know whether Mr. Nadin's experiment of coating the timber was successful.

On the motion of the Chairman (Mr. Thomas Beech), seconded by Mr. W. M. Waterhouse, a very cordial vote of thanks was accorded to Prof. Groom for bringing this important subject before the members. Their pleasure had been greatly enhanced by the brilliant *viva-voce* address to which they had listened.

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